Stoller
Hanford Office

DOE-EM/GJ1273-2006

299-W18-09 (A7526)
Log Data Report

Borehole Information:

Borehole: 299-W18-09 (A7526)		Site: 216-Z-18 Crib			
Coordinates (WA St Plane)		GWL[1] (ft): None		GW Date: 01/19/06	
North	East	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
135302.121	566472.961	12/68	686.06	220.0	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel	3.0	6 5/8	6 1/16	9/32	3.0	220

Borehole Notes:

The logging engineer measured the casing stick-up and diameter using a caliper and steel tape. Logging data acquisition is referenced to the TOC. Hanford Wells reports the casing is perforated from 180 to 218 ft. In 1972, a 5-in. screen was emplaced from 182 to 212 ft. A wood plug was placed at 217 ft. No grout is reported to have been used in this borehole. Groundwater levels were reported at 194 ft and 211.5 ft in 1968 and 1991, respectively. No groundwater is evident in the borehole at the current time.

Logging Equipment Information:

Logging System:	Gamma 4N		Type: SGLS (70%) SN: 34TP40587A
Effective Calibration Date:	08/16/05	Calibration Reference:	DOE/EM-GJ953-2005
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 4I		Type: PNLS SN: U1754
Effective Calibration Date:	Not required	Calibration Reference:	None
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 4F		Type: NMLS SN: H380932510
Effective Calibration Date:	10/14/05	Calibration Reference:	DOE/EM-GJO1020-2005
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	4	5	6	7
Date	01/20/06	01/23/06	01/24/06	01/24/06	01/25/06
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	218.0	170.0	118.0	75.0	46.5
Finish Depth (ft)	169.0	117.0	74.0	45.5	20.0
Count Time (sec)	100	100	100	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	0.5	0.5
ft/min	N/A[2]	N/A	N/A	N/A	N/A
Pre-Verification	DN151CAB	DN161CAB	DN171CAB	DN171CAB	DN181CAB
Start File	DN151000	DN161000	DN171000	DN171045	DN181000
Finish File	DN151049	DN161053	DN171044	DN171104	DN181053
Post-Verification	DN151CAA	AE161CAA	AE171CAA	AE171CAA	AE181CAA
Depth Return Error (in.)	-1.5	0	N/A	N/A	N/A
Comments	Fine gain adjustment at files -000 and -001.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.

Log Run	8	9 Repeat	10 Repeat		
Date	01/25/06	01/25/06	01/26/06		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	21.0	30.0	28.5		
Finish Depth (ft)	3.0	27.5	24.0		
Count Time (sec)	100	400	400		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	1.0	0.5	0.5		
ft/min	N/A	N/A	N/A		
Pre-Verification	DN181CAB	DN181CAB	DN191CAB		
Start File	DN181000	DN181073	DN191000		
Finish File	DN181072	DN181078	DN191009		
Post-Verification	AE181CAA	AE181CAA	AE191CAA		
Depth Return Error (in.)	- 1	0	0		
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.		

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	11	12	13 Repeat	14	
Date	01/26/06	01/26/06	01/30/06	01/30/06	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	218.0	128.0	106.0	83.75	
Finish Depth (ft)	127.0	84.0	84.0	3.0	
Count Time (sec)	N/A	N/A	N/A	N/A	
Live/Real	N/A	N/A	N/A	N/A	
Shield (Y/N)	N	N	N	N	
Sample Interval (ft)	0.25	0.25	0.25	0.25	
ft/min	1.0	1.0	1.0	1.0	
Pre-Verification	DF102CAB	DF102CAB	DF112CAB	DF112CAB	
Start File	DF102000	DF102365	DF112000	DF112089	

Log Run	11	12	13 Repeat	14	
Finish File	DF102364	DF102541	DF112088	DF112412	
Post-Verification	DF102CAA	DF102CAA	DF112CAA	DF112CAA	
Depth Return Error (in.)	N/A	0	N/A	-1	
Comments	None	None	None	None	

Passive Neutron Logging System (PNLS) Log Run Information:

Log Run	2	3 Repeat			
Date	01/23/06	01/23/06			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	75.0	33.0			
Finish Depth (ft)	2.0	24.0			
Count Time (sec)	60	60			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	DI302CAB	DI302CAB			
Start File	DI302000	DI302074			
Finish File	DI302073	DI302083			
Post-Verification	DI302CAA	DI302CAA			
Depth Return Error (in.)	N/A	N/A			
Comments	None	None			

Logging Operation Notes:

Logging was conducted with a centralizer on each sonde and measurements are referenced to top of casing. Repeat data with the SGLS were acquired at 400 second counting time at 0.5 ft intervals to provide additional detail of the highest activity zone.

Analysis Notes:

Analyst:	Henwood	**Date:**	08/01/06	**Reference:**	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after each day's data acquisition. The acceptance criteria were met.

A casing correction for 9/32-in.-thick casing was applied throughout the borehole.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G4NAug05.xls using an efficiency function and corrections for casing and dead time as determined from annual calibrations. Volumetric percent moisture was calculated using worksheet G4FOct05.xls. The passive neutron logging system data are used for qualitative purposes and does not require a calibration.

Results and Interpretations:

241Am is detected between 24 and 61 ft and between 68 and 71 ft. The maximum concentration is measured at approximately 400,000 pCi/g at 27 ft. Gamma rays at approximately 662, 722, and 208 keV were detected that may represent 241Am. 137Cs emits a 661.62 gamma ray that cannot be distinguished from the 662.40 gamma ray emitted from 241Am. A corroborating energy peak at 722.01 keV is used to establish the presence of 241Am rather than 137Cs. In this borehole the 722.01 keV energy peak is used to determine the 241Am concentration. A minor amount of 137Cs (i.e., approximately 0.1 pCi/g) appears to exist. The 208.01 keV energy peak of 241Am is elevated relative to the 722.01 keV energy peak, suggesting an interfering gamma ray at this energy.

239Pu is detected between 25 and 53 ft and between 58 and 61 ft. The maximum concentration is measured at approximately 400,000 pCi/g at a 27.5 ft depth. An evaluation of 239Pu energy peaks determined the 375.05 energy peak had no significant interferences and is used to calculate concentrations.

As mentioned above, there appear to be interfering gamma rays at an energy of approximately 208 keV. These gamma rays are likely the 208.01 keV 241Am and 208.00 keV 237U gamma rays. 237U is a decay product of 241Pu, which is in equilibrium with its parent, so that an assay of 237U represents the activity of 241Pu. After subtracting the counts of the 208.01 keV gamma line emitted by 241Am (based on the 722.01 keV energy peak) from the total counts in the 208 keV energy peak, a maximum activity of 16 pCi/g is estimated for 241Pu.

Weapons grade plutonium is generally considered to be in approximate proportions of 94% 239Pu, 6% 240Pu, and 0.005% 241Pu. Using these proportions, 240Pu could be expected to be on the order of 24,000 pCi/g and 241Pu at 20 pCi/g. The reason for the difference in 241Pu estimates is, in part, attributed to decay of 241Pu (half life of approximately 14 years) since it was deposited in the crib.

237Np is detected with the SGLS by measuring a daughter product (protactinium-233 (233Pa)) that emits a prominent gamma ray at an energy of 312.17 keV. 233Pa was detected between 25 and 62 ft and between 67.5 and 71.5 ft. The maximum concentration is approximately 19 pCi/g at a 27 ft depth.

A slightly elevated 232Th concentration, as determined using the 2615 keV (208Tl) energy peak, is indicated between 25 and 29 ft; other less prominent indications are at approximately 33 ft and from 43 to 46 ft. The plot of natural gamma logs shows the disruption of the equilibrium of the natural 232Th decay, where the 228Ac indicates 232Th concentrations below that calculated from the 2615 keV gamma line. This difference is attributed to the existence of 232U which shares the same decay chain as 232Th, beginning at 228Th. 228Th is the first daughter of 232U and the third daughter of 232Th; 228Ac is the second daughter of 232Th. To determine the concentration of 232U, the activity due to natural decay of 232Th, must be subtracted. The 228Ac concentration is subtracted from the 232Th concentration calculated based on the 2615 keV 208Tl energy peak. The result is a maximum concentration of approximately 1 pCi/g 232U. For the naturally occurring 232Th, the 2615 keV peak is used to calculate concentrations except for the interval where 232U is indicated; 228Ac is used for the 232Th assay at these depth locations.

233U almost certainly exists where 232U is detected. In a reactor using thorium target material, 233U will be generated at roughly three orders of magnitude more than 232U. However, at relatively low concentrations, 233U does not emit a gamma ray that can be detected with the SGLS. Decay products that potentially could be measured, have not had sufficient time to grow into equilibrium with their parent so that detection is possible. It is inferred on the basis of the 232U concentration that less than 300 pCi/g 233U may exist in this waste stream.

Passive neutron logging was performed in the borehole from the ground surface to 75 ft. This logging method has been shown to be effective in qualitatively detecting zones of alpha-emitting contaminants from secondary neutron flux generated by the (α,n) reaction and may indicate the presence of α-emitting nuclides, including transuranic radionuclides, even where no gamma emissions are available for detection above the MDL. The passive neutron signal depends on the concentration of α sources, and also the concentrations of lighter elements such as N, O, F, Mg, Al, and Si that emit neutrons after alpha capture. The passive neutron log indicated a maximum count rate of 8 counts per second (cps) at 27 ft. This count rate can be contrasted with that observed in the 216-Z-1A and 216-Z-12 cribs where the count rates can exceed 2000 cps. Part of the reason for the lower count rate is the lower concentrations of transuranics, thus less alpha activity, relative to the other cribs. However, it is likely the dominant cause is that the Pu and Am do not exist as fluoride compounds. 19F has a much higher capture cross section for alpha particles, compared to other light elements such as oxygen or nitrogen. No prominent peaks associated with alpha capture by fluorine were apparent in the spectra suggesting the isotopes of Pu and Am may be in a nitrate or oxide form in this crib.

The neutron moisture logging plots indicate volumetric moisture in percent. Variations are observed throughout the borehole and may aid in interpreting lithology changes.

The repeat logs all show good repeatability.

List of Log Plots:

Depth Reference is top of casing
Depth Scale - 20 ft/inch except for repeat logs
Man-Made Radionuclide Plot (0-120 ft)
Man-Made Radionuclide Plot (110-230 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Combination Plot (0-120 ft)
Combination Plot (110-230 ft)
Total Gamma, Dead Time, Passive Neutron & Moisture (0-160 ft)
Total Gamma, Dead Time, Passive Neutron & Moisture (150-310 ft)
Man-made Radionuclides Repeat Plot (24-30 ft)
Repeat Section for Natural Gamma Logs (24-30 ft)
Repeat Sections for Passive Neutron & Moisture

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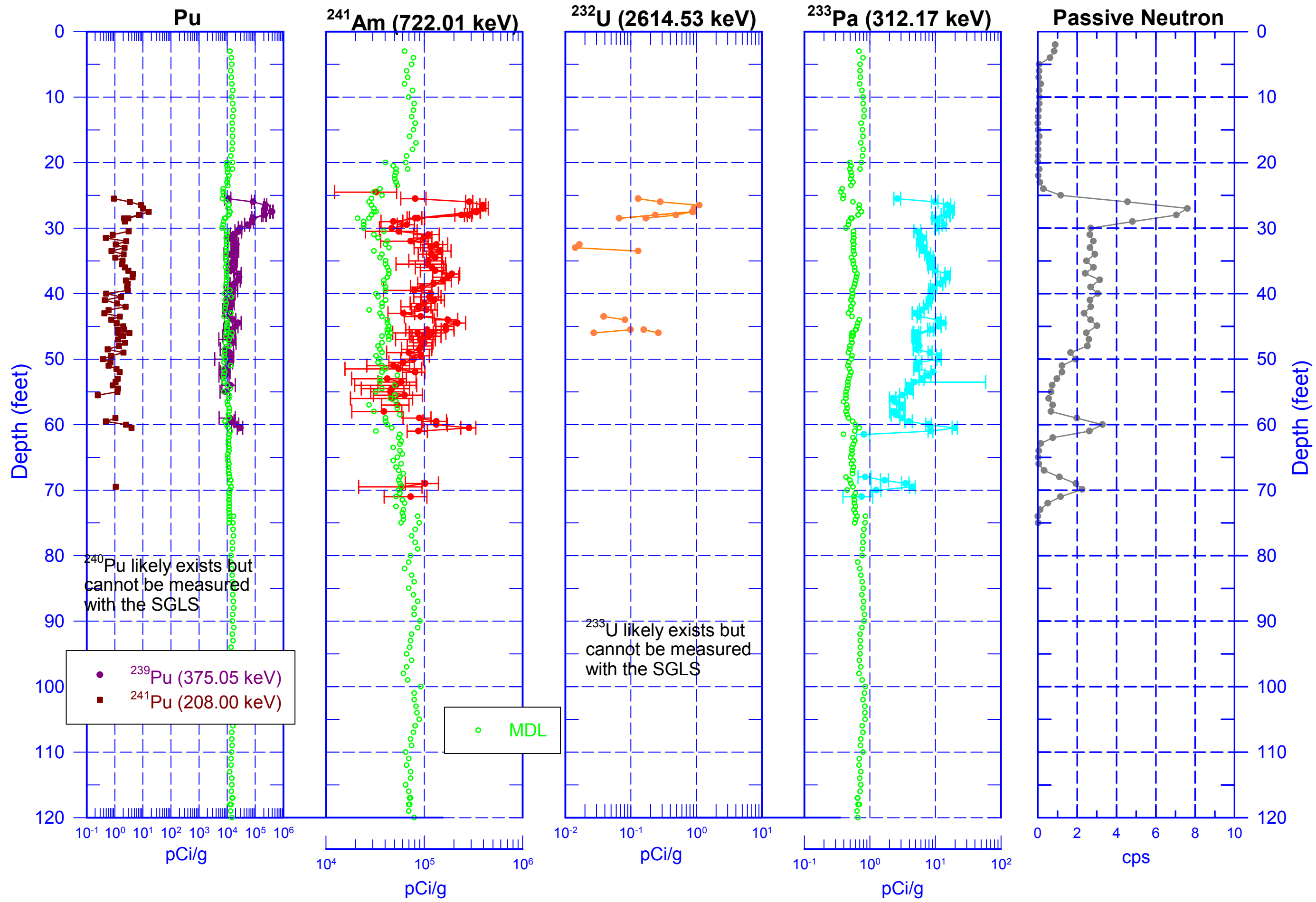
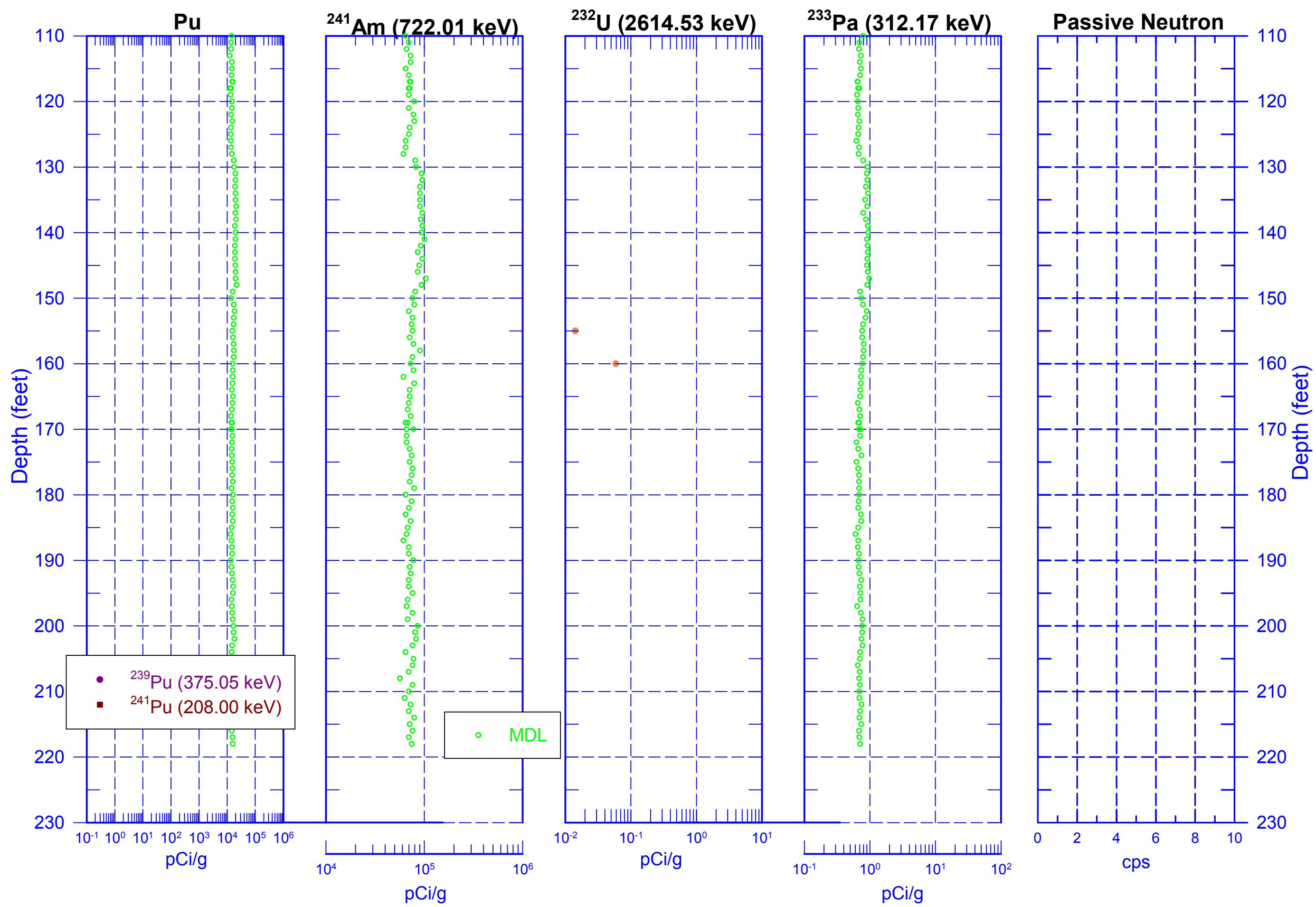
[1] GWL – groundwater level
[2] N/A – not applicable

299-W18-09 (A7526) Man-made Radionuclide Plot



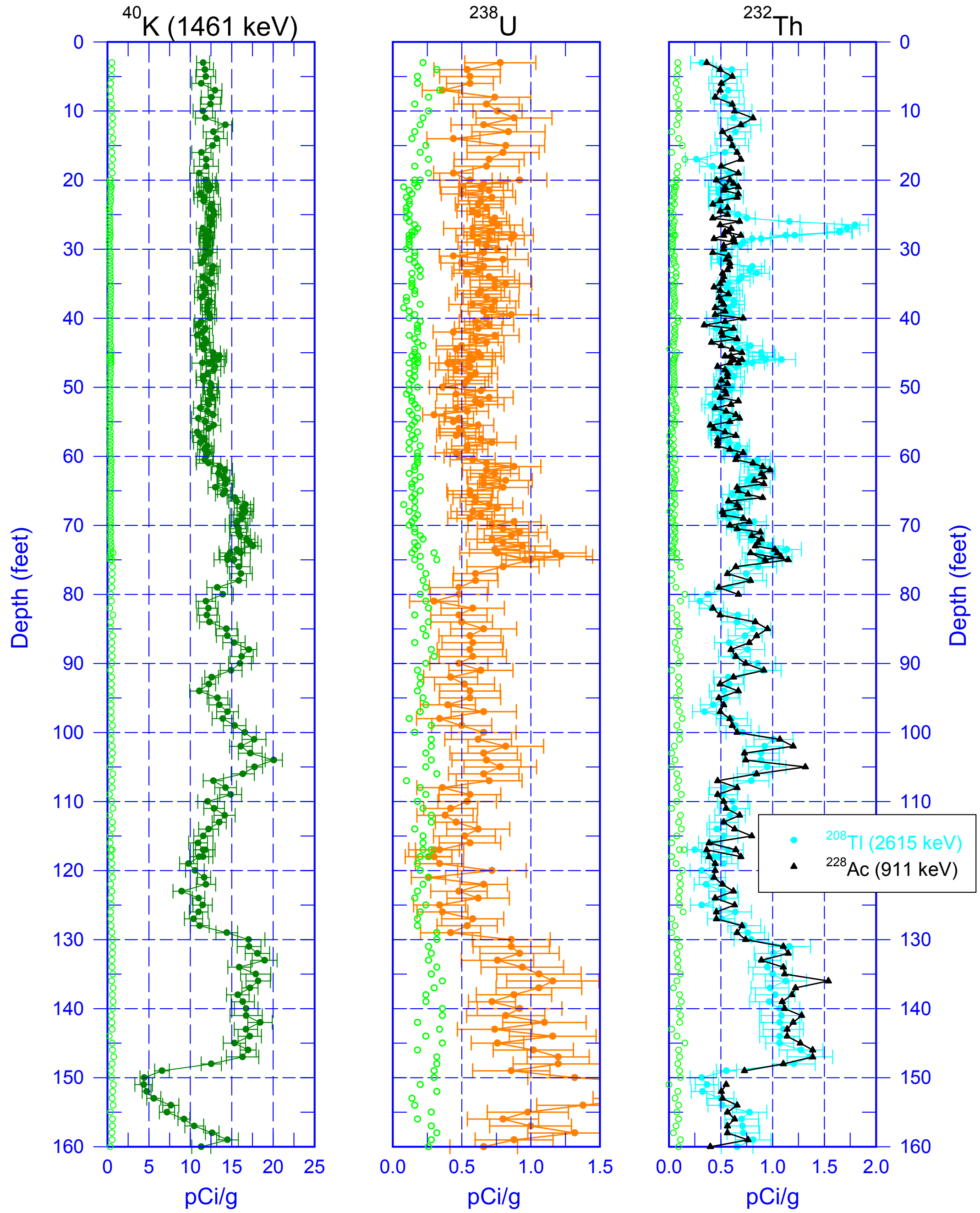
Zero Reference = Top of Casing

299-W18-09 (A7526) Man-made Radionuclide Plot



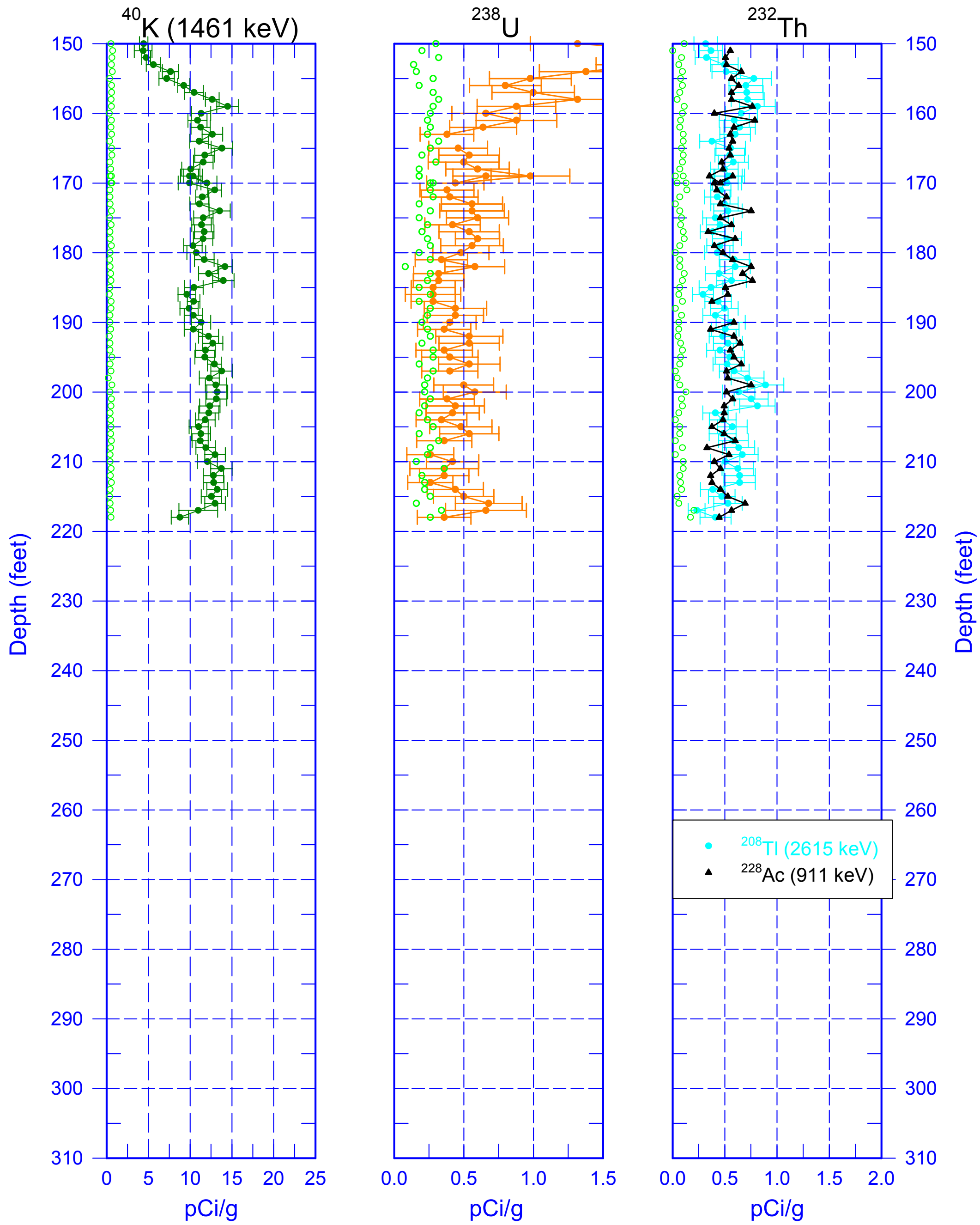
Zero Reference = Top of Casing

299-W18-09 (A7526)
Natural Gamma Logs



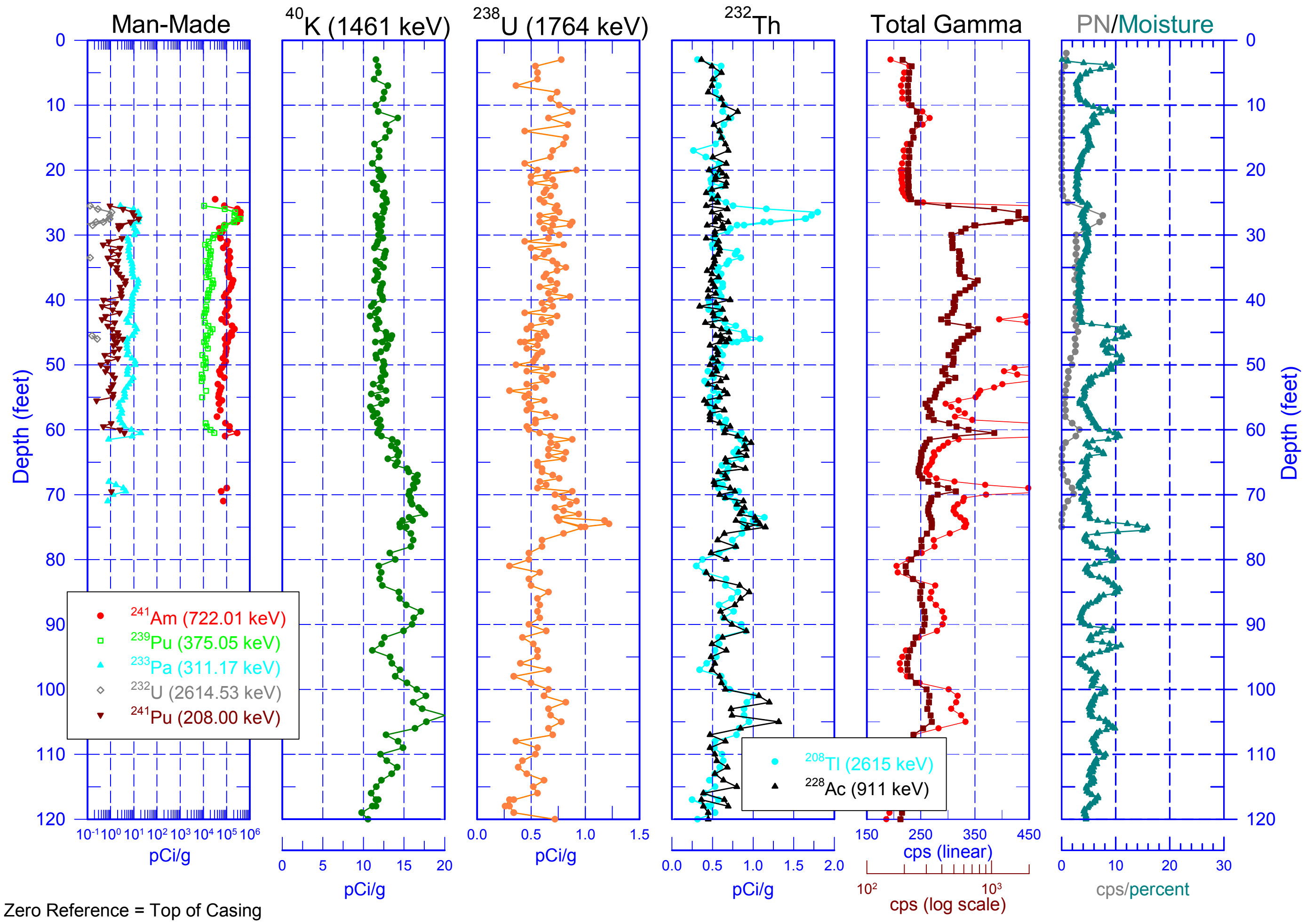
Zero Reference = Top of Casing

299-W18-09 (A7526)
Natural Gamma Logs



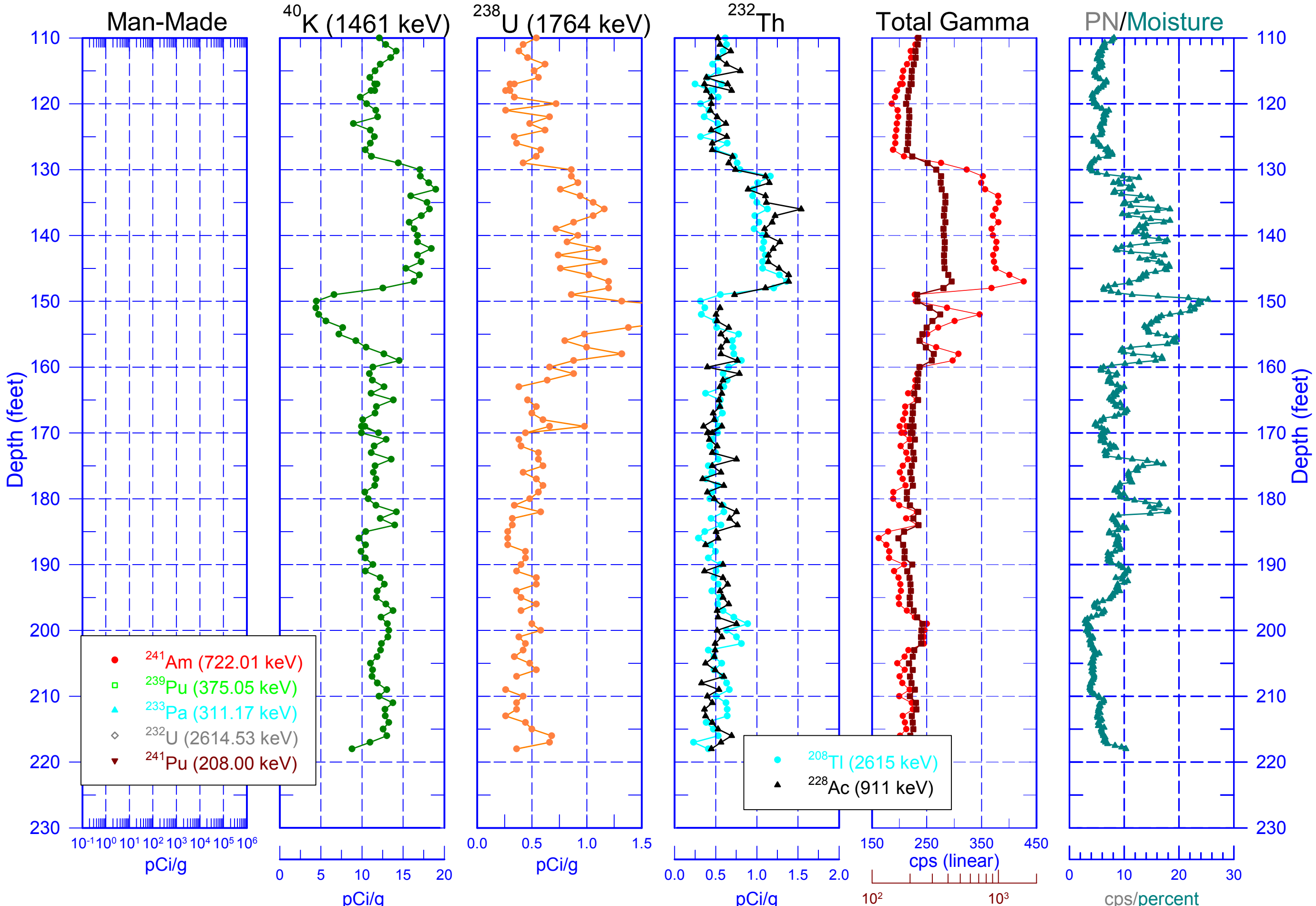
Zero Reference = Top of Casing

299-W18-09 (A7526) Combination Plot



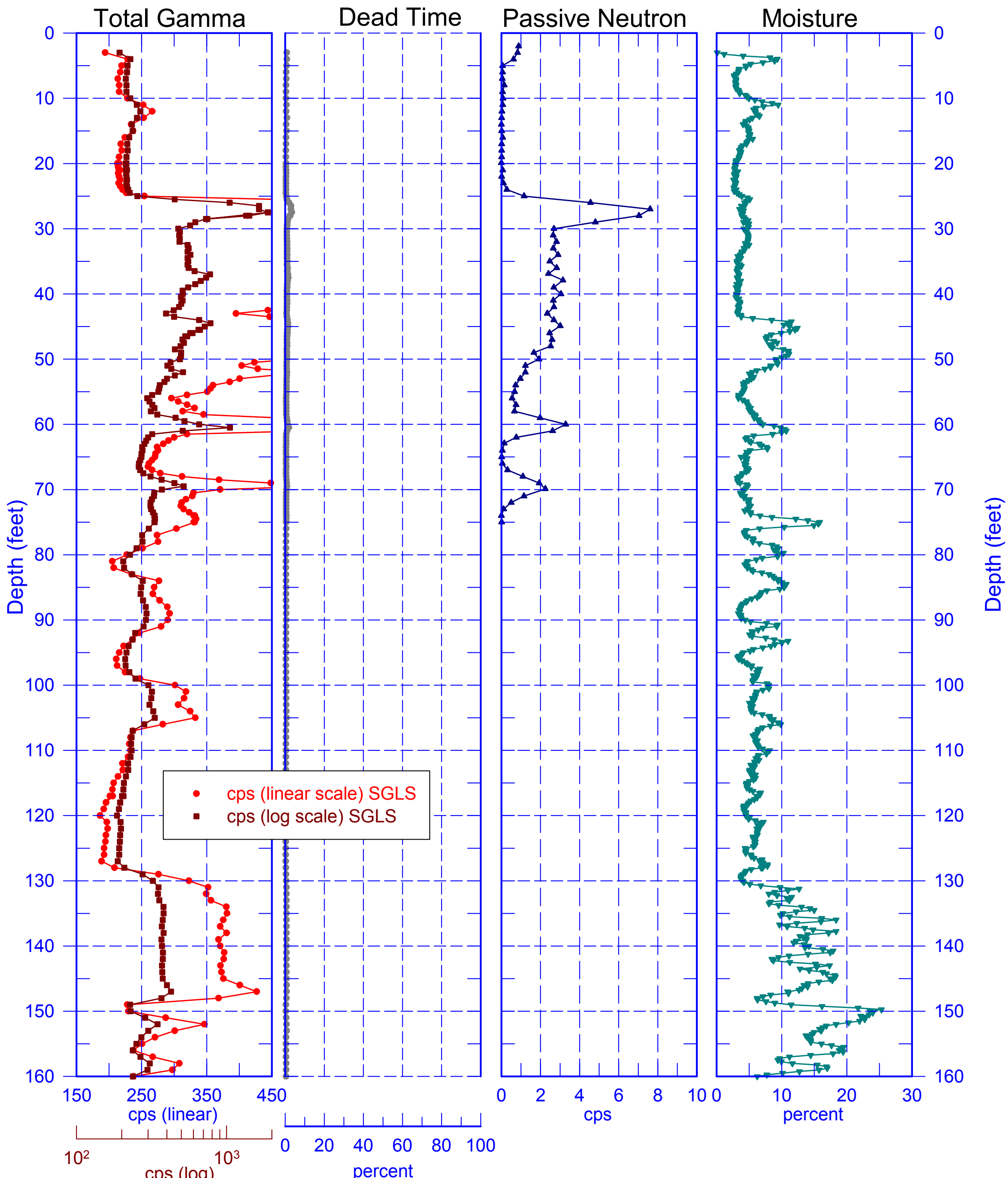
Zero Reference = Top of Casing

299-W18-09 (A7526) Combination Plot



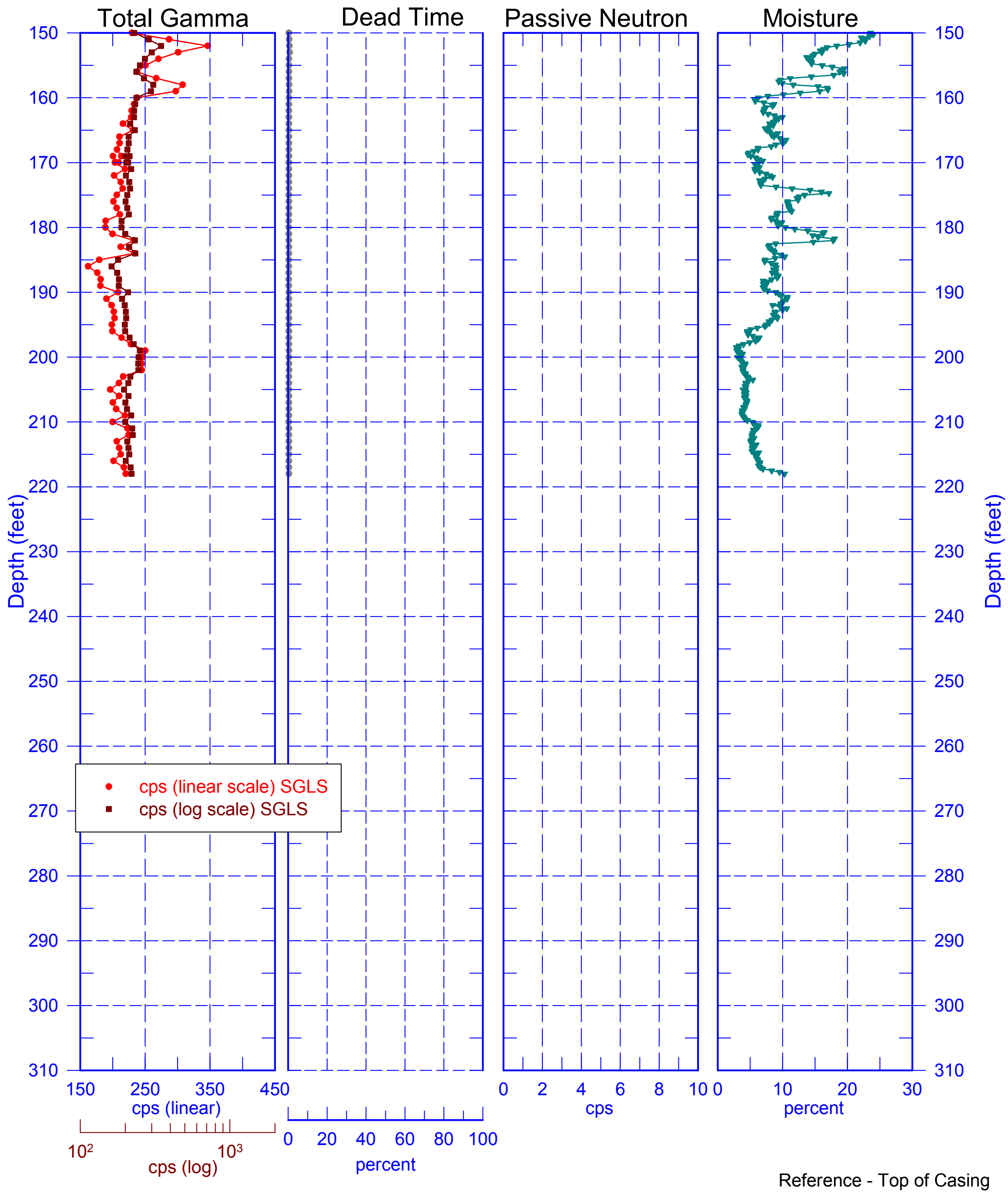
Zero Reference = Top of Casing

299-W18-09 (A7526)
Total Gamma, Dead Time, Passive Neutron & Moisture



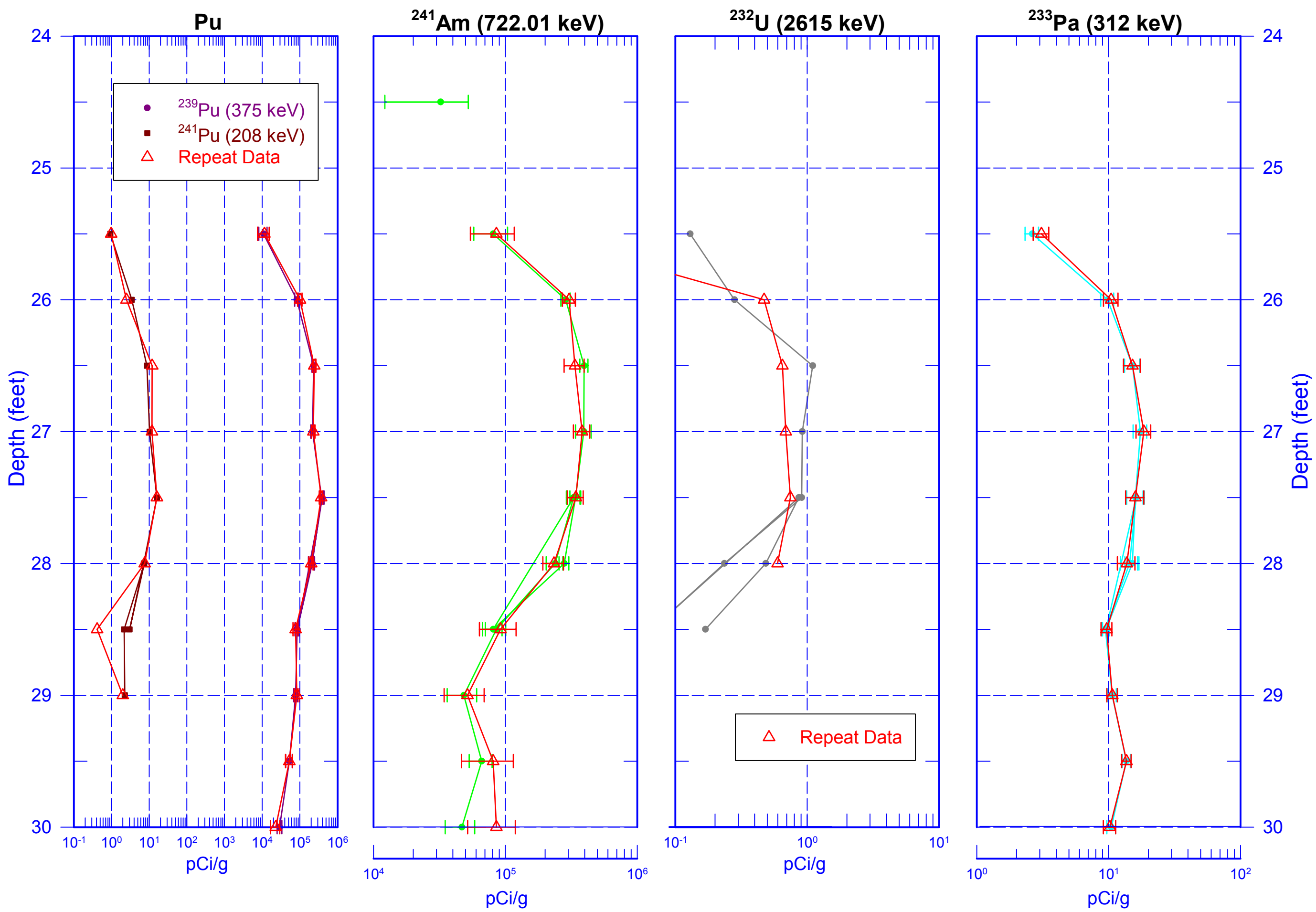
Reference - Top of Casing

299-W18-09 (A7526)
Total Gamma, Dead Time, Passive Neutron & Moisture



Reference - Top of Casing

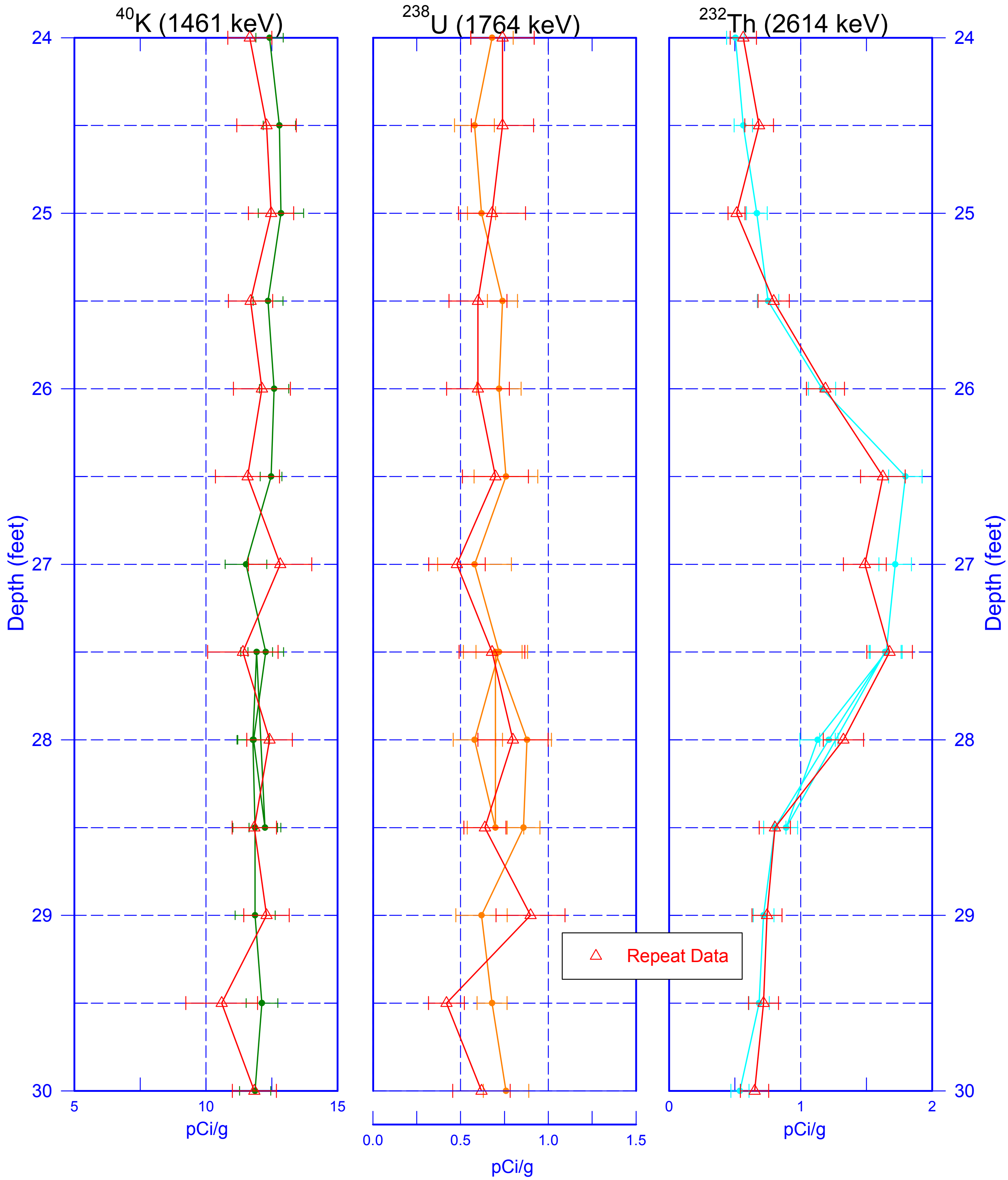
299-W18-09 (A7526) Man-made Radionuclides Repeat Plot



Zero Reference = Top of Casing

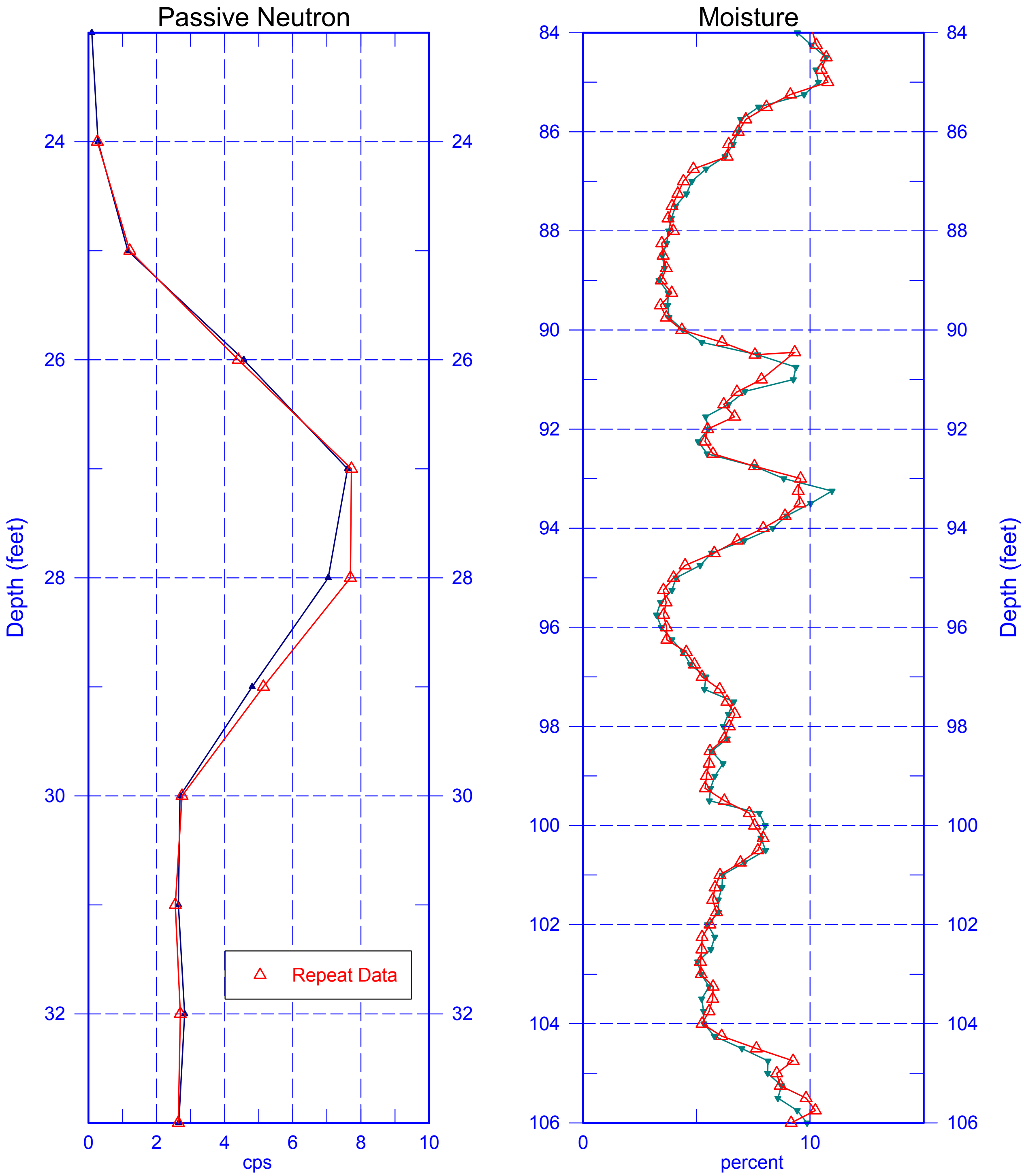
299-W18-09 (A7526)

Repeat Section of Natural Gamma Logs



Zero Reference = Top of Casing

299-W18-09 (A7526)
Repeat Sections for Passive Neutron & Moisture



Reference - Top of Casing